# REPORT RESUMES

ED 020 135

SE 004 629

EDUCATION IN NATURAL RESOURCES, PROCEEDINGS AND RELATED PAPERS FROM A SEMINAR SERIES AT COLORADO STATE UNIVERSITY 1963-64.

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COLORADO STATE UNIV., FT. COLLINS

PUB DATE 64

EDRS PRICE MF-$0.50 HC-$4.08 100P.

DESCRIPTORS- *CURRICULUM, *CONSERVATION EDUCATION, *EDUCATIONAL PROGRAMS, *HIGHER EDUCATION, *NATURAL RESOURCES, CONFERENCE REPORTS, FEDERAL GOVERNMENT, GRADUATE STUDY, SCIENCES, SOCIAL SCIENCES, STATE FEDERAL SUPPORT, UNDERGRADUATE STUDY,

REPORTED ARE THE SEMINAR PAPERS AND PROCEEDINGS OF A CONFERENCE WHICH INVESTIGATED THE FIELD OF NATURAL RESOURCES AND MADE RECOMMENDATIONS ON THE COURSE AND DIRECTION OF NATURAL RESOURCES STUDY AT THE COLLEGE OR UNIVERSITY LEVEL. THE CONFERENCE AND SEMINARS HELD AT COLORADO STATE UNIVERSITY DURING 1963-64 GAVE PARTICIPATING FACULTY MEMBERS AN OPPORTUNITY TO DRAW UPON THE IDEAS AND EXPERIENCE OF KNOWLEDGEABLE PERSONS ENGAGED IN THE STUDY AND PRACTICE OF RESOURCES MANAGEMENT. PART 1 IS A COMPENDIUM OF A CONFERENCE, "TRAINING IN NATURAL RESOURCES FOR GOVERNMENTAL PERSONNEL," ATTENDED BY REPRESENTATIVES FROM THE VARIOUS UNIVERSITY DEPARTMENTS AND FROM STATE AND FEDERAL AGENCIES. PARTS 2-5 RELATE THE TEXTS OF SEMINAR PAPERS, PRESENTED BY RECOGNIZED AUTHORITIES WHO DISCUSSED PROVISIONS FOR DEVELOPING TRAINED, PROFESSIONAL PERSONNEL IN THE NUMEROUS FIELDS OF NATURAL RESOURCES. UNANIMITY WAS NOT PRESENT FOR ALL ISSUES. HOWEVER, IT WAS CONCLUDED THAT (1) AN UNDERGRADUATE CURRICULUM IN NATURAL RESOURCES IS DEFENSIBLE AND MAY BE DESIRABLE AS A "GENERAL EDUCATION" OR "LIBERAL ARTS" TYPE PROGRAM, (2) MOST PRESENT UNIVERSITY PROGRAMS ARE INADEQUATE IN PROVIDING NECESSARY TRAINING FOR RESOURCE MANAGERS, (3) A SPLIT-MAJOR MIGHT BE AN ANSWER TO THE PROBLEM POSED IN ITEM 2, (4) THERE IS A NEED FOR REVISION OF THE GRADUATE PROGRAM (SUGGESTED REVISIONS ARE INCLUDED), (5) INCREASED EXCHANGES OF PERSONNEL BETWEEN RESOURCE ORGANIZATIONS AND THE UNIVERSITY WOULD BE DESIRABLE, AND (6) THERE SHOULD BE BETTER COORDINATION OF RESEARCH BETWEEN THE UNIVERSITIES AND COOPERATING AGENCIES. (DS)

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# EDUCATION IN NATURAL RESOURCES

Proceedings & Related Papers
from
A Seminar Series
at
Colorado State University
1963-64

Edited by
Phillip O. Foss

SE004629

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Library of Congress Catalog Card
Number 64-64914

Sponsored by
Committee on Education in Natural Resources
Natural Resources Center
Colorado State University
and
The Conservation Foundation

Edited by
Phillip O. Foss

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## in
## Natural Resources
## 1963-64

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# INTRODUCTION

In the Fall of 1962 a Task Committee in Natural Resources was appointed by the President of Colorado State University to generally investigate the field of natural resources and to make recommendations on the course and direction of natural resources studies in the university.

The Task Committee recommended the establishment of a Natural Resources Center to coordinate research and education programs with a resources content. This recommendation was adopted and the basic organizational structure has now been established.

Partially as a result of the interest generated by the Task Committee, a separate Committee on Education in Natural Resources was formed to study the subject "Natural Resources: What to teach and how to teach it."

Since a substantial proportion of graduates in the various resources specialties are employed by government, the Committee first solicited the advice of the various Federal and State of Colorado resource agencies in the form of an all-day conference held on August 8, 1963. Proceedings of that Conference and a roster of participants are included in this report.

The Committee next arranged a series of faculty seminars on the same subject (Natural Resources: What to teach and how to teach it.) with each seminar session chaired by a recognized authority in some field of natural resources. The papers presented during this seminar series comprise the major portion of the report. Seminar chairmen were supplied with copies of previous papers in an effort to obtain a cumulative effect.

The principal purpose of the Conference and the seminar series was to provide the faculty of Colorado State University with an opportunity to draw upon the ideas and experience of knowledgeable persons engaged in the study and practice of resources management. However, the Committee believes that the thinking of the participants in this endeavor may be of value to both resource managers and educators and has consequently compiled and made available the proceedings and related papers contained in this report.

The seminar series was supported in part by a grant from the Conservation Foundation of New York City. Views expressed in this report are those of the speakers and do not necessarily reflect the opinions of the Conservation Foundation or of Colorado State University.

June 1964 Phillip O. Foss
Professor of Political Science
Colorado State University

# SEMINAR ONE

## SUMMARY OF PROCEEDINGS
## SEMINAR ON TRAINING IN NATURAL RESOURCES FOR GOVERNMENTAL PERSONNEL

Colorado State University
August 8, 1963

### Participants

A roster of participants follows this report. Representatives were present from: Council of Economic Advisers, Office of the Chief Executive; Forest Service, USDA; Bureau of Land Management, USDI; Public Health Service, HEW; Bureau of Sport Fisheries and Wildlife, USDI; Bureau of Outdoor Recreation, USDI; Economic Research Service, USDA; Soil Conservation Service, USDA; Bureau of Reclamation, USDI; Corps of Engineers, Dept. of the Army; Colorado Water Conservation Board; Colorado Department of Game, Fish and Parks; and Colorado State University.

### Guidelines for Discussion

Since participation in the seminar was restricted to government agency representatives and faculty, the disucssion was oriented towards the training needs of personnel in government resource managing agencies.

Prior to the seminar, agency representatives were given the list of questions which follows as a guide fo discussion.

# SOME MATTERS WHICH SHOULD RECEIVE THE ATTENTION OF THE SEMINAR ON TRAINING IN NATURAL RESOURCES FOR GOVERNMENT PERSONNEL

Note: We hope agency representatives will be prepared to comment on these items.

1. Are training programs, conducted by universities, for government personnel of high potential, necessary or desirable?

2. If so, what kind of training should be offered?

    a. Training to advance the student in his specialization, eg. a soil scientist might undertake graduate work in the same field.

    b. Broadening or "gap-filling," eg. a budget officer in the Bureau of Land Management might benefit most from work in Range Management, Technical Writing or Politics.

    c. Training in Management or Public Administration. The person whose training and experience has been specialized in a technical field is not likely to possess the skills and understandings needed in an administrative position.

    d. All three of the above.

3. Should training be carried out in regular established university courses?

    a. At the graduate level?

    b. At the undergraduate level?

    c. Is formal course credit necessary or desirable?

    d. Should training be aimed towards a degree?

    e. Does the quarter system (approximately 12 weeks) fit into this type of program?

4. Would a "core curriculum" plus enrollment in regular courses be preferable to item 3 above?

    (Core curriculum would be composed of two or three courses open only to in-service training personnel)

   a. What should be the content of such a core curriculum?

   b. How should it be taught?

5. Should an entirely new curriculum be devised especially for personnel of the resource agencies? Note: the cost of such a program would be considerably higher than that suggested under items 3 and 4 above.

   a. What should be the content, orientation, or approach in such a curriculum?

   b. Most desirable timing and length of course?

   c. For university course credit?

   d. Leading to, or culminating in a degree?

6. Would a new major and a new graduate degree in Natural Resources be desirable?

   a. What should be the content of such a major?

   b. Would graduates be employable by the resource agencies at a level equal to holders of more specialized traditional degrees?

   c. Would graduates have equal or better promotional opportunities in the agency?

7. What is the value of short courses or institutes?

   a. What time of year is best?

   b. What kinds of subject-matter are best suited to the short course?

   c. What kinds of teaching approaches seem most effective for the short course?

8. From the viewpoint of your agency what kinds of research do you consider to have highest priority?

9. What kinds of university programs, including but not restricted to the above, would your agency be most likely to support in terms of sponsoring students for in-service training?

## Proceedings

The morning session was devoted mainly to presentations by Colorado State University personnel. Vice President A. R. Chamberlain discussed the present and anticipated role of CSU in the Colorado System of state supported higher education and its advantages for education in natural resources.

Dean Clinton Wasser outlined existing programs in the departments of Forest Management and Utilization, Forest Recreation and Wildlife Conservation, Range Management and in the Watershed Management unit and commented on possibilities for additional graduate work in these areas.

Professor D. B. Simons described the work of the engineering departments on campus including present and planned research activities and the additional research opportunities made possible by the completion of the new Engineering Research Center.

Professor Donal D. Johnson outlined the contributions and possibilities of the agricultural sciences, including Soil Science and Genetics, for natural resources study and research possibilities.

Professor Don Seastone emphasized the need for, and possibilities of, increased participation of Business Administration and the Social Sciences in natural resources training.

Professor Phillip O. Foss suggested some alternative kinds of inservice training for natural resource managers and developed a series of questions for commentary from representatives of the various government agencies present at the seminar.

## Undergraduate Training

The seminar was intended to focus on the training needs of mature resource managers or resource staff personnel with high growth potential. However, several participants stressed the need for improvement in undergraduate training. Deficiencies in verbal skills and in the social sciences were most frequently mentioned. The need for a broader base of "basic scientific courses" also received considerable attention. In the words of one participant "if you will educate them, we will train them." The basic problem in undergraduate training appears to be mainly a problem of time i.e., how can professional standards be attained plus the needed additional training in basic sciences, verbal skills and the social sciences in the time available? In the words of an old folk song, we are "fighting the battle of time."

## Necessity for Additional Training

There was general agreement that a real need existed for training to upgrade present or potential resource managers and staff personnel of high capability. According to one seminar member, "We are eight to ten years late in initiating such a program."

Participants also generally agreed that the sooner the individual of high potential is recognized and given additional training the greater will be his contribution to the agency.

## Advanced Training in Original Specialty

There was general agreement that additional training to advance the student in his field of original specialization is desirable mainly for research personnel and technicians. In the later instance, short, specialized courses to up-date the technician may be most desirable. For the research scientist, formal specialized education to the Ph. D., and beyond, is becoming more common.

## Broadening and Gap-Filling Education

There appeared to be unanimous agreement that the greatest educational need was of a broadening and "gap-filling" nature. The need for training in verbal skills, basic sciences and social sciences was again emphasized.

Several members warned, however, that such training should have the effect of "adding to" rather than "diluting" the student's field of specialized knowledge. It appeared tha the government agencies represented desired most the individual who was trained in depth in a particular specialty plus additional broad training in both the arts and sciences.

## Public Administration

One discussant emphasized the need for the kind of person who could supervise personnel trained in several different technologies without "abdicating" to any of them because of lack of knowledge.

There was general agreement that administrators and potential administrators could benefit greatly from courses in Public Administration. It was pointed out that the technician turned administrator has had no training or experience in administration and that the effective administrator possesses a "battery" of skills and understandings which the technician cannot acquire except through chance observation of administrators.

## Courses and Curriculum

Most members of the seminar believed that training might best be carried forward through existing university courses with some possible additions in the field of conservation principles and ecology. One member pointed out, however, that a new curriculum would probalby grow out of the effort to develop high-level resource managers and staff personnel.

## The Core Course Concept

With one or two exceptions, the concept of the core courses(s) received general acceptance. Such a course(s) would presumably be restricted to agency personnel. Several members warned, however, that the core course(s) must not become a "social hour," desirable as that might be, but that it must be a "rough," "hard," "challenging" experience.

There was some disagreement as to whether a core course(s) should be given for formal academic credit. The restricted membership of the course and varying content might present problems in awarding credit.

It was suggested that a considerable portion of the core course(s) be devoted to the consideration of real, current resources problems. It was further suggested that membership be held down to a number that would be conducive to a seminar approach.

## Formal Academic Credit and Graduate Degrees

A majority of the confreres believed that formal academic credit should be granted for work completed and that working toward a graduate degree was generally desirable. However, course credit for short, specialized courses was not considered to be necessary.

## The Quarter System

The quarter arrangement seemed to be most satisfactory especially for training programs of short duration.

## A New Major in Natural Resources?

A proposal to establish a new curriculum and a new degree in natural resources met with a mixed response. Some agency representatives said they would be glad to employ a graduate of such a program and that his promotional prospects in the agency would be as good, or better, than those of persons trained along more specialized lines.

Other agency representatives expressed doubts as to both the employability and promotability of such a person.

However, there seemed to be almost unanimous agreement that a person possessing one of the conventional, specialized undergraduate degrees plus a graduate degree in natural resources would possess a most desirable educational background.

## Short Courses and Institutes

Short courses or "institutes" were considered to be necessary and desirable mainly for introducing new techniques or equipment and for generally updating personnel in their field of work. There was some disagreement as to whether or not such short courses should be conducted by a university.

## Recurrent Themes

The recurrent theme of the day's discussion was the need for "broadening" and greater understanding of interrelationships. Participants stressed the need for "de-specialization," for appreciation and understanding of the problems of other agencies and jurisdictions, and the need for positive and innovative problem solutions. "We need people who can utilize technology in the social milieu in which they must function" seemed to summarise the viewpoint of many confreres. "Getting the job done in an arena of many sharply contending factions" might be another expression of the desires of some seminar participants.

A second matter that was mentioned several times was the need for cross-fertilization not only among government agencies but also between agencies and universities. It was noted that university faculty frequently work in government but that the reverse seldom happens. The kind of training considered by the seminar would provide one channel for a kind of "delayed feedback" from agency personnel back to the university.

# ROSTER
# SEMINAR ON TRAINING IN NATURAL RESOURCES FOR GOVERNMENT PERSONNEL

August 8, 1963

Colorado State University

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Calvin M. Bowen
Chief, Employment and Training, Bureau of Land Management, USDI.

M. F. Brewer
Council of Economic Advisers, Office of the Chief Executive, Washington, D. C.

A. R. Chamberlain
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Professor of Agronomy, CSU.

Keith Kelso
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Kenneth Nobe
Bureau of Outdoor Recreation, USDI.

George A. Pavelis
Economic Research Service, USDA.

L. R. Reed
Soil Conservation Service, USDA.

Laurence E. Riordan
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Professor of Civil Engineering, CSU.

Felix L. Sparks
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Charles Terwilliger
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J. V. K. Wager
Professor and Head, Department of Forest Recreation & Wildlife Conservation.

Clinton H. Wasser
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Ira A. Watson
Chief, Economics Branch, Bureau of Reclamation, USDI.

Eugene W. Weber
Deputy Director of Civil Works for Policy, Corps of Engineers, U. S. Department of the Army.

## SEMINAR TWO

### EDUCATION IN NATURAL RESOURCES

Stephen H. Spurr
Dean and Professor,
School of Natural Resources
The University of Michigan

Presented at
Colorado State University
February 6, 1964

Before discussing the general topic of Education in Natural Resources, it is necessary to define the phrase "natural resources" because it is a phrase that has meanings and interpretations at various levels of integration.

In the broadest sense, natural resources refers to all of the human aspects of the human environment that relate to man's welfare and happiness. In this sense, we may think of human ecology in the broadest possible terms and can concern ourselves with the human ecosystem in which mankind is interrelated with all of the factors of his environment, whether atmospheric, terrestrial, or biotic. In the study of this human ecosystem, our natural resources have an important bearing upon the history, development, and welfare of human communities. This is a valid definition of natural resources; but we should note that at this level of integration, natural resources deals with a great portion of human knowledge, and education in natural resources becomes almost synonymous with education in general.

At a somewhat less inclusive level of integration, we think of natural resources as the specific products of the earth needed for humans, industry, and even life. Here we concern ourselves with water, air, minerals, agricultural products and the soil upon which they are grown, forests, and the land forms upon which we live. At this level of integration, we are dealing with a subject matter roughly akin to that covered by the conventional department of geography in a university. A program of education in natural resources at this level would be akin to a major in geography in a literary or liberal arts college. The very fact that we would be considering an educational program in natural resources might be taken to imply a criticism of the existing program in geography on the basis that it is too descriptive and not sufficiently philosophical or scientific; but does not imply that we are necessarily doing something new or original in the establishment of a natural resources curriculum.

At the third level of integration of the natural resources concept, we are reduced to the consideration of relatively few natural resources which seem capable of being managed or regulated so as to specifically affect human wealth and welfare. Here we talk of the "renewable" natural resources and of "conserving" those natural resources in danger of depletion or otherwise in short supply. At this level, natural resources becomes something of a synonym for conservation, a synonym that is being proposed and adopted because the new term is a better one than the old one. Conservation simply means the act of saving or preserving, and this implies to our modern intellectual society a "lock the door" or "put a fence around it" sort of policy that is inconsistent with management under scientific, economic, and ecological principles. We may redefine conservation as "wise use", but our definition will not be understood or accepted by a large share of our listening public. In this sense, natural resources is simply a new and better term than conservation; but yet a term that requires an understanding both on the part of the speaker and the listener as to the specific definition and meaning implied.

I take it that it is with this third and more strictly limited level of integration that we are concerned today. Before exploring it further, however, we should realize that in common practice, we normally restrict the term of natural resources even more. Natural resources is, in many uses, not a synonym for conservation but a synonym for certain aspects of conservation. The School of Natural Resources at The University of Michigan is concerned formally only with forestry, wildlife management, fisheries, natural resource planning and administration, and outdoor recreation, although the faculty is expanding its interest into closely related fields. Similarly, it is currently proposed to rename the Michigan Conservation Department, the Michigan Department of Natural Resources along the lines pioneered in California and several other states. In contrast, the Natural Resources Institute at Ohio State University is but little concerned with forestry and agriculture. Finally, it has been seriously proposed that land-grant colleges rename their shcools of agriculture as schools of natural resources. Certainly, agriculture and agricultural products constitute perhaps our single most important natural resource, one in which human civilization is indeed primarily based. Thus, the field of natural resources as viewed by one person or organization may be quite different from that thought of by others.

It follows from consideration of these levels of integration of the national concept of natural resources, that there are an infinite number of educational programs possible that could carry the name. I suggest we consider very briefly the possibility of programs in natural resources first as a philosophical or liberal arts subject andsecond as a professional subject.

As a liberal arts curriculum, the concept of natural resources seems to offer a valid base for an undergraduate education either at the first two-year or at a four-year level. In such a philosophical program leading to the A.B. or B.S. degree, the unifying theme would be the human--natural resource ecosystem, and the student would devote a major portion of his time as an undergraduate to understanding not only the various components of this ecosystem but the interrelationships that exist between them. Such a program would have few required courses but would rather be built on the distribution and concentration requirements characteristic of liberal arts programs everywhere.

Many existing college courses would form the basis for study of the existing portions of the ecosystem--courses in anthropology, history, sociology, economics, geology, meteorology, biology, etc. The chief new contribution that would have to be made would be to provide instruction in the interrelationships. We would have to provide courses at the various levels making clear the nature of the human--natural resource ecosystem and the way in which each part is dependent upon every other part. It should be obvious to all of us that it is extermely difficult to find faculty competent to teach such courses, and even when selected, it is difficult for them to adequately define what and how they should teach. Yet a start can be made. At The University of Michigan, we are offering a course in "natural resources ecology" taught by faculty in the School of Natural Resources but offered in the College of Literature, Science, and the Arts and accepted by the curriculum committee of that College as meeting the natural science distribution requirement. This course, taught the first year by Professor Stanley A. Cain and to be taught the second year by Professor John Bardach, represents our first effort to intrigue the underclass student in the human ecology relating our natural resources to mankind. We hope that it will intrigue a portion of our entering college classes to continue their study of natural resources, either at a philosophic or a professional level.

As I think that I have already implied, this philosophic curriculum in natural resources could be either essentially on a two-year basis preparing students to enter into professional programs, or it could constitute in itself a four-year undergarduate program leading to a liberal arts baccalaureate. In any event, it would be broad and far ranging in its subject matter and its philosophical implications, and I believe that it would provide as good a liberal education as could be obtained in any discipline or any interdisciplinary subject that has yet been proposed.

Broadly based interdisciplinary programs such as I have suggested above have their attraction and their value. Nevertheless, many of us are concerned with earning a living, and many of us feel the need of leaving our consideration of the general to become competent in the particular. For these purposes, professional courses in specific natural resources areas can be built upon the philosophic base of the liberal arts curriculum in natural resources to provide professional training in specific areas. At The University of Michigan, where we depend to a very large extent upon transferring colleges from liberal arts, we normally conceive of these professional courses as beginning with the summer camp between the sophomore and junior year or at the beginning of the junior year. Obviously, however, for practically minded and professionally directed students, it is desirable to introduce professional courses earlier in the college career. Otherwise, the practically-oriented student may have difficulty maintaining his interest through early broadly based study until he can arrive at the more specific and vocationally-directed professional courses.

Of the various professional options open to the undergraduate student, whether or not he enters them at the junior year or with a course or two taken earlier, agriculture is obviously the first and most important. At the same time, many of the programs in undergraduate agriculture available today in land-grant colleges are not as broadly based in their liberal arts background nor as professional in the highest sense of the term as I am suggesting that such a program should be.

Forestry in its broadest sense is also a natural resource profession that is well established, that has philosophic as well as a practical basis, and that has consistently turned out men that have provided leadership to the entire natural resource movement. Wildlife management, range management, and fisheries management are other wild area natural resource disciplines rapidly developing and rapidly reaching professional status. Outdoor recreation may not be a discipline in itself, but it surely is a measure of the urban interest in space and the out-of-doors, and the human need of getting away from the city. It is a movement that must be brought to bear upon our natural resource programs in our colleges and universities.

Water resource management deals with our most important single natural resource. Urban development, agricultural production and human life itself, of course are all dependent upon water. The importance of water is being belatedly recognized in our universities but it has not yet been accorded the recognition of specific programs leading to specific professional employment that it deserves. I suggest to you that the profession of the water resources manager is potentially the most important of the natural resource professions. Finally, air management is becoming increasingly important.

Air management is already a practical problem in such urban areas as Pittsburgh, Los Angeles, and London. It is becoming increasedly cogent and of immediate human importance throughout much of the rest of the civilized world. Whether we are concerned simply with the elimination of the impurities in the air, with the control and regulation of radioactive fallout, or with the management of weather in the broadest sense, we must agree that we are on the threshhold of an era when air management will be equally important to water management and land management in controlling human destiny.

In closing my formal remarks, then, my thesis is a simple one: first, that the study of the human natural resource ecosystem is a valid basis for a liberal arts education either on a two-year or four-year basis. Second, that professional programs beginning at approximately the junior year of the undergraduate curriculum would provide young men and women the opportunity of combining a liberal arts training in the philosophic and scientific basis of the human ecosystem with a practical and professional specialty that would enable them to participate actively in the management of a portion of this system. There will be many such specialties falling under the general areas of land, water, and air management. Some of these professions are already well established although the subject matter in their present day curricula should be constantly under review and revision. The need for others is already here, and we should begin actively to develop curricula to meet these needs. Still others will be with us in the near future, and it is not too early to begin thinking as to how we may best anticipate human needs in future natural resource management.

## SEMINAR THREE

### EDUCATION IN NATURAL RESOURCES

Sol D. Resnick
Hydrologist and Professor
Institute of Water Utilization
The University of Arizona

Presented at
Colorado State University
February 17, 1964

The Senate Select Committee on National Water Resources several years ago concluded that by 1980 the number one natural resource shortage of the nation will be fresh water. This shortage is resulting mainly because of a steadily rising population, increased use of water per capita, pollution of existing supplies and increased use of arid regions for irrigated farming.

To solve these water resources and associated natural resources problems, there will be ever increasing need for trained personnel in these fields. To set forth the needs in education in natural resources, with emphasis on water resources, the problems of the arid Southwest will be examined.

#### Increased Efficiency in the Use of Existing Water Resources

The water resources problem of the Southwest can be at least partially alleviated by increased efficiency in use of existing supplies. Following are some of the programs for achieving increased efficiencies and the type of trained personnel required to accomplish these programs.

Considering losses of about 850,000 acre-feet of water on an average annually from Lake Mead alone, one can readily appreciate the importance of the efforts to suppress evaporation from both water and land surfaces. In the limited efforts of the Institute of Water Utilization in a cooperative agreement with the U. S. Bureau of Reclamation in this regard, the talents of physical chemists, chemical and civil engineers, and agriculturalists, such as soil physicists, have been utilized. Of course, economics is an underlying factor in all of these programs.

One of the most critical problems in the Southwest today is the diminishing groundwater supply. The average yearly overdraft on the groundwater reserves in Arizona alone is approximately three and one-half million acre-feet. By means of artificial groundwater recharge, flood waters that are normally lost by nonbeneficial evapotranspiration are placed in the underground reservoir. For this program, the Institute has required the talents of geologists, civil engineers, and agriculturalists, such as soil physicists and chemists. Our major problems have not been technical however; economics is again a major factor, but obtaining legal right to utilize even flood waters that would otherwise be lost is the major problem.

Irrigators in the middle reaches of the Gila River insist on the water not being used even though their flood rights essentially lost their meaning when tributaries to the Gila River, like the Santa Cruz, became intermittent with the drop in groundwater levels. This points up the need for political scientists and lawyers with an understanding of hydrology.

Since only a small part of the water that falls as precipitation in the Southwest is effectively used, research is being conducted in watershed management to determine if eradication of non-beneficial plants will increase timber, forage, and water. Over one million dollars is being spent annually in Arizona alone in cooperative studies involving The University of Arizona, Arizona State Land Department, the United States Forest Service, Geological Survey, and the Bureau of Indian Affairs. The program consists of block and strip cutting of spruce and fir, thinning of ponderosa pine, and eradication of juniper, pinyon, phreatophytes, and non-beneficial chaparral. A program like this, of course, requires personnel of varied training in natural resources. Technical procedures, economics, water rights, relative importance and value of increased water yields, if any, grass and timber production, erosion control, and recreation are some of the factors that need to be considered.

On an 18 square mile watershed near Tucson, Arizona, the average runoff for the past three years has been barely three per cent of the precipitation - the rest of the water is essentially lost by non-beneficial evapotranspiration. To increase water yields, small areas are being paved with various materials such as asphalt. Chemical sprays, which can be applied from airplanes, are being considered for large areas. As above this program requires personnel of varied training in natural resources. Among the many factors to be considered, special attention would have to be given to location of paved areas and water rights.

The largest single use of water by far in the Southwest is for irrigation; yet, Dr. O. W. Israelsen, one of the most eminent authorities on the subject, estimates that only about 35 per cent of the water diverted for irrigation is ever used by the growing crop. A 10 per cent increase in irrigation efficiencies in Arizona alone would result in a saving of 700,000 acre-feet of water - this is nearly five times the yearly amount used by both Tucson and Phoenix. Some of the special factors that need to be considered are: (1) Adjustment of water rights as physical irrigation systems become more efficient and through research more efficient crop varieties, with regard to water use, are developed. (2) Means of convincing irrigators that the last acre-foot of pumped water applied although providing an increment to his yield could be more effectively used in the future. And (3) value of water, if not a replenishable supply, for future domestic and industrial use.

The reuse of domestic and industrial waste waters affords many different special considerations. Sanitary engineers, microbiologists, and medical technologists with an understanding of hydrology and agriculture are required; social scientists also trained in these fields are needed to convince the public that properly treated reused water has a place in their life, as well as to vote for those bond issues insuring pollution control. While Maricopa County politicians argue, approximately 50,000 acre-feet of treated sewage effluent annually is essentially wasted by being dumped into the Salt River - water is thrown around as though it were only money.

## Increasing the Amount of Available Water Resources

Following are some of the programs for increasing the amount of available water resources and discussed are the type of trained personnel to accomplish these programs.

Increasing precipitation if possible by cloud seeding brings into play a host of special problems that require the attention of personnel with widely different interests but all with a fairly thorough understanding of water resources. Besides the meteorologist responsible for the technical manipulations and evaluations, for example, lawyers, politicians, political and social scientists would have to settle local, state, national, and international disputes over water rights and damages.

Demineralization of sea and brackish water involves both technical and economic problems even though one can sympathize with the sanitary engineer, associated with an interior plant, who has carloads of unwanted salt on his hands.

Increasing available water resources by importation, of course, presents many interesting problems. The technical aspects seem simple when compared to the economic, social and political aspects. Political and social scientists and lawyers trained with reference to water resource management are urgently needed to resolve the problems, for example, within and between Arizona, California, and Baja, Mexico. Even in a brief exposure to a water suit, such as the recently concluded Colorado River case between Arizona and California, a scientist quickly learns that the scientific method is not necessarily the universal approach to the solution of natural resource problems.

## Suggested Educational Training in Natural Resources

To train the personnel to cope with the problems presented in the development, conservation and utilization of natural resources, the following educational program is suggested.

Split majors on both the undergraduate and graduate levels in fields covering the physical, biological, and social aspects of natural resources are suggested. A single coordinator concerned with both education and research in natural resources responsible directly to the president of the university but operating with a committee of deans and one of subject-matter personnel is desirable. However, the training itself could be accomplished probably within the existing framework of departments.

The coordinator and committees would be responsible for determining the nature of the core courses, establishment of special broadly conceived courses to survey a resource field, and coordination in both education and research.

In the physical sciences a flexible core curriculum could be established for split majors in hydrology with geology, engineering, agriculture, or meteorology; in water resource management with watershed management, agricultural engineering, or soils and agronomy; and in water resources economics with geography or agricultural economics. Basic courses should be stressed but otherwise flexibility is desirable. Specially conceived courses, for example, in soils, plant physiology, meteorology and climatology, geology, geography, fluid mechanics, watershed management, economics, political science, law, and even in social studies are necessary to broaden the outlook of the student in the field of national resources. Text books for this purpose need to be developed and teaching personnel trained. Perhaps six month seminars on beginning and advanced levels should be established to train the teaching personnel required for a program like the above. For example, a plant physiologist already well versed in plant-soil-water relationships may be given further intensive training in hydrology, climatology, etc. With this additional training, he no doubt could develop a course suited, for example, to the engineering hydrologists.

Similar consideration should be given to developing split majors in the biological and social sciences as required.

As the population of the country and of the world continues to grow, it is safe to predict increasing emphasis on the study and understanding of problems associated with natural resources in all their many forms and a continuing expansion of employment opportunities for those broadly trained in the development, conservation, and utilization of natural resources.

## SEMINAR FOUR

# UNIVERSITY PROGRAMS IN THE FIELD OF NATURAL RESOURCES

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Presented at
Colorado State University
March 5, 1964

Since about 1950 American universities have given increasing attention to programs in natural resources defined as a broad field. Prior to that time many institutions had developed important programs dealing with an individual resource or activity -- such as forestry or irrigation -- but in more recent years there has been a growing interest in the field as a whole or in larger components of it than were previously considered. As a result, at least one university has a school of natural resources and several have institutes or departments of natural resources or conservation. Here in Colorado State you have initiated a program in watershed management and now you are seeking to integrate with increasing effectiveness all of the University's activities in the broad field of natural resources.

These changes that have been under way at many

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The views expressed are those of the author and not necessarily of his organization.

education institutions reflect a growing recognition throughout the United States that the relation of man to the natural environment and the operation of the primary industries remain important, that relationships are changing rapidly and resulting in both complex and serious problems in the United States and throughout the world. We have come to appreciate that the relationship of man to natural resources will continue to change and open up new problems and opportunities which will merit scientific study and consideration.

But the efforts of the universities to initiate broader programs in the field of natural resources have encountered a number of difficulties. Financing has not been easy, in part because the major universities have been facing so many new and pressing demands. Fitting a natural resource program into the university structure and determining what purpose and who it should be designed to serve has been a complex question. Organizing and managing an integrated research effort has been difficult in view of the fact that numerous traditional disciplines are involved.

The purpose of this paper is to offer a few observations on these somewhat perplexing problems. In view of my own limited experience on these matters and the relatively brief study I have given to them, I do not presume to have definitive answers.

## The Function of the University

In searching for solutions to the problems of designing natural resources programs and fitting them into the university structure, it is important to keep in mind the historic role of the university in American society.

The major universities of the United States are the product of two somewhat different conceptions of higher education. One conception I will call the classic ideal of the university. According to this conception the purpose of the university is the quest for knowledge. The objective is to stimulate intellectual endeavor of the highest order. To accomplish this the scholar is left free to pursue whatever avenues of study and thought challenge his interest, unhampered by administrative responsibility, a teaching load, or pressure to meet a given time schedule in the production of results. His only training responsibilities are to work with mature individuals who aspire to advanced scholarship and who could be expected to carry on scholarly activity into the future. According to the advocates of this conception, institutions of this kind are of major importance because "civilized mankind looks to this quest for matter-of-fact knowledge as its most valued achievement." It is the cornerstone of western civilization; it is the foundation for the loftiest ideals and standards of value that are the aspiration of western society.

The second conception which provides the basis for the modern university is reflected in the motivations which resulted in the establishment of the land grant colleges. These institutions, promoted by egalitarian ideals characteristic of this nation, were designed to serve the broad and varied educational requirements of people generally. Research and education was directed in the first instance to the needs of a particular state or region. This type of research, focussed upon the practical problems of particular areas, has met with striking success as reflected in the dramatic progress of American agriculture. Educational activities which emphasize professional training and extension have produced an enormous number of effective individuals and assured the wide application of knowledge to productive enterprises.

As time goes on, these two conceptions -- the classical ideal of the university and the college as an advanced training institution and service center for people generally -- have merged and we have as a consequence the great land grant universities which serve our nation so well. Yet amid the pressures that bear upon a university today, it is important not to lose sight of the two somewhat different and often competitive purposes a good university must serve. On the one hand, it must continue to provide both the support and the environment in which scholars will have the opportunity for development. On the other hand, it must provide on an expanding basis to an ever more complex society, professional training and practical research results for people generally.

My impression is that universities face a very difficult task in performing these functions on a fully satisfactory basis. The rapid growth in demand for higher education as reflected in rapidly increasing enrollments cause one type of difficulty. The rapid advance of science and technology quickly alter the requirements of up-to-date professional training. The enormous amounts of money made available by the federal government and the foundations in support of research have tended to determine the patterns of scholarly effort rather than the pattern being determined by the interests of the individual scholar.

In designing a university program of research and education in the field of natural resources, it behooves us to remain faithful to the basic objectives of the modern university, and in particular not to lose sight of the classic ideal because the task of the university is considerably more than the solution of practical and immediate problems; it must also contribute in a very substantial way to the ethical and philosophical progress of mankind.

## Financing Research and Education Programs in the Field of Natural Resources

I am sure that you would be pleased if I could tell you how to secure the funds you require to support research and educational programs in the field of natural resources without encountering some of the difficulties you now face. Instead of trying to do that, I propose to comment on the responsibility of the university on those who grant funds to the university in support of such programs.

Implicit in the classic ideal of the university is the view that the individual scholar will have considerable freedom to pursue lines of inquiry which he finds attractive. Those of us interested in higher education are confronted with the problem of maintaining that freedom in view of the amounts of money available to foster predetermined lines of research. It is probably no exaggeration to say that we face the question of whether determination of the lines of inquiry to be pursued is to pass completely from the scholar to governmental agencies and foundations. To suggest that this result would be unfortunate is not to impugn the motives or question the ability of agency or foundation representatives, nor am I implying that grants and contracts to support particular lines of research are undesirable. What I mean to indicate is that the able scholar should not be limited to such sources of support because the scholar himself deserves a voice in the decision as to the type of study that merits his attention.

The only logical answer to this problem is for university budgets to include funds for general support of research by faculty members which cannot be supported under appropriate conditions in other ways. This is essential if the university is to perform one of its most important functions, namely the provision of an environment where the quest for knowledge for its own sake may be pursued. I know that this view is widely recognized, but I wish to add my voice to those of the others who are concerned about the extent to which research emphasis is determined by programs of momentary popularity.

The fund granting and research contracting institutions also have a responsibility in this regard. I am well aware that universities and university faculty members would prefer to have more general support grants than they now receive. The realities are that organizations, such as Resources for the Future, have been established to serve specific objectives and their own continuance is dependent upon the effectiveness with which they achieve those objectives. At the same time I feel that the fund granting institution can administer its support in such a way that it does not do violence to the basic objectives of the university.

At Resources for the Future it is our objective to match our interests with those of the research scholar who is independently interested in the kind of research we wish to encourage; we do not go out to buy research. Then by handling our grant relationships -- the exploration of the objectives and content of the research profit -- through our own scholars who are actively engaged in related lines of research, we feel that a good and sympathetic understanding can be achieved between ourselves and the principals who undertake the research. Although we expect funds to be effectively used, comments on and criticism of research results are given and we hope received as the comments and criticisms of one scholar to another. We believe through these processes better research results are achieved and universities are strengthened.

## The Design of Educational Programs

I am not qualified to speak about the details of the various curricula that might be established in the field of natural resources. There are, however, some fairly general observations about the nature, objectives and content of educational programs which I would like to offer.

## The Natural Resources Generalist

A question that frequently arises is whether the university should be providing training for what might be called natural resources generalists. Some universities are granting degrees in this field, particularly at the masters level. One possibility is to establish a specialized program in public or business administration as related to natural resources. My observations on this point are quite subjective inasmuch as my own training is in the field of political science and public administration.

My views may appear rather traditional or old fashioned. The university trains personnel to engage in professional work or in research. For professional work, the immediate question is whether there are sufficient employment opportunities of a given type to merit a special kind of professional training. My impression is that there is relatively limited employment opportunity for the individual who has generalized training through, let us say, a masters degree. I recognize that the federal government and some state and local agencies employ a few people in which a general background is desired. Yet, in comparison with the demand for specialists -- economists, foresters, engineers, etc. -- the demand appears to be very limited. The person who has a degree in public administration, and who has a general background in natural resources, tends to find himself limited to budget work, personnel work, general services administration, and similar activities. For the person substantively interested in the field of natural resources, such assignments are limiting and frustrating.

For research work, my feeling is that specialization in a particular discipline is almost essential. Effective research requires a body of theory and a system of analysis. A person with generalized training, by definition, seems to lack the essential tools for effective research activity.

## Government, Economics and Professional Training

In my own work in the federal government and the contacts that I have made about the country since I have been with Resources for the Future, it is my impression that the professional training generally provided in the natural resources fields is deficient in at least one important respect in view of the kinds of responsibilities individuals in these professions are expected to assume. I am referring to such professions as engineering, forestry, range management, etc. These professions have a public service character The individuals who work in these fields are either employed by government or if not employed by government, they engage in activities which directly affect the public interest in an important way. The construction of a dam, the management of a forest, the installation of a sewage treatment facility not only affects the values realized by the owner of the land or the project, but almost invariably has an effect upon others in society. I seriously question whether individuals trained in these professions today are adequately prepared for the public responsibilities which are thrust upon them.

To be more specific, I believe that serious consideration should be given to strengthening the training of people in these fields in two respects. For one thing, they should have courses of instruction in political science and public administration so they may gain a better understanding of the political foundations of our society, of governmental processes, and of the ethical responsibilities of the public servant and the citizen. The professional in the field of natural resources also should have some training in what is usually called welfare economics. He needs to understand economic consequences which extend beyond the facility with which he is specifically concerned or which arise under conditions when the market does not function effectively.

Since I've arrived I've been asked whether I felt that engineers should have some training in the biological sciences so they might gain a better appreciation of the natural environment which the structures they build influence and alter so greatly. I do not have a clear answer to this question. I do feel that those who engage in the natural resources professions should receive a kind of training through which the individual learns that a major consequence of his work is to influence the nature of the human environment and that he has a major responsibility to be sensitive to environmental values no less than the other values with which he deals.

In short, individuals who work in the natural resources professions are more than technicians. They are dealing with matters which have a direct and significant bearing upon public values within a political environment. These responsibilities should be recognized in professional training even though this necessitates a longer training period.

## Advanced Training of the Experienced Professional

One of the real opportunities for the universities in the field of natural resources education is in the provision of additional training for those who are already engaged in the natural resources professions. Three kinds of training might be envisaged, namely (1) retooling, (2) training for public responsibility and (3) training for administrative and policy responsibility.

As a consequence of rapid scientific advancement and technological change the professional needs to up-date and diversify his training from time to time in order to keep abreast of advances in his profession. Such retooling may be necessary at five or ten year intervals for a given individual, depending upon what is happening in his field and the kind of work he is doing. Certainly this need is no less important in the natural resources professions than in other fields. I'm in no position to suggest how such programs should be organized and administered. Circumstances vary from profession to profession and individual to individual. It seems logical that everything from short, intenseive, refresher programs to those of a year or more merit consideration.

Of foremost importance is the need for remedying what I consider to be the basic deficiency in much professional training today and in the past, namely that of providing individuals with the background necessary to discharge the public responsibilities inherent in natural resources professional work. If we are to achieve the degree of sophistication to which we aspire, in planning programs of natural resources development and management, in evaluating their consequences and in relating them to the realities of American political processes, a fairly substantial number of people throughout the natural resources professions require a kind of training in government, economics and public policy which they did not receive when they got their training initially and which they do not acquire on the job. I have no well developed formula for a program designed to achieve this objective but I believe that universities, in cooperation with government officials in particular, might well give careful consideration to what such a program might include and how it should be organized, managed and supported.

The university should be prepared to aid the specialist, the individual who has been trained and who has worked in one field, such as forestry, to become an administrator or to occupy a staff position or a planning post in a natural resources agency. It is at this point that quite intensive training in administration, public policy, public decision making, and economics becomes of paramount importance. Public agencies generally select their administrators from among the professional ranks. This is an appropriate as well as a natural phenomenon. However, my own experience has indicated that many individuals well qualified in their own professions are ill prepared to assume the duties of supervision, staff analytical work, or general planning. The government agencies, industry and the universities should work together to develop strong programs to equip individuals trained and experienced in the professions to occupy positions of this nature.

It is self-evident that some programs might be designed to serve all three of the purposes I've described. An individual might return to do some retooling in his own specialty, to advance his understanding of government and economics, and to prepare himself for an administrative or policy position.

## The Doctoral Program

In developing a program in the field of natural resources, the doctoral or research degree program should not be neglected. If a dynamic intellectual environment is to be provided, research and advanced study is essential. It is important to the young scholar who chooses research as his career; it is both an obligation and an opportunity for the faculty member to help develop the new generation of those interested in the advancement of knowledge; it is what makes the university an attractive and worthwhile location for advanced professional training.

Again, I wish to emphasize that I do not envisage a doctors degree in natural resources generally but in a discipline which has a body of theory and a system of analysis. The focus of the research, however, can be on natural resources problems.

## Faculty Development

A university which seriously undertakes educational programs in the field of natural resources faces the question of how best to equip its faculty for these responsibilities. Among the things that might be done, I would rank high on the list, an arrangement whereby faculty members actually gain experience in the resource agencies and firms. Summer employment, consulting assignments are useful but of distinctly limited value, because the faculty member gains so little insight and understanding in this way. Leaves-of-absence for appointments of a year or more in government and industry are preferable. It is difficult to exaggerate the importance of this kind of experience so that faculty members will understand the environment from which many of there students come and to which they eventually go.

## Design of the Research Program

Before offering some comments on specific lines of research, I wish to make clear that I recognize fully that any research program at a university must be built around the interests and qualifications of the faculty and students. The research interests of the university may have some bearing upon the qualifications and interests of the faculty members the university seeks to employ, but once a man is selected and on the staff it is essential that he be given a great deal of freedom to engage in the kinds of research which attract his interest.

Also, I wish to emphasize the importance of cooperative activity among the disciplines in the field of natural resources. Our own experience at Resources for the Future clearly indicates that substantial gains in understanding frequently can only come through the joint and collaborative efforts of social scientists, physical scientists and biological scientists. I believe the social scientist can serve in a key role in the design and functioning of a research program. A substantial motivation for much of the research in the field of natural resources will continue to be the desire to improve the welfare of mankind. Implicit in this general objective is the concern for values and the functioning of human institutions in realizing these values. The social scientist who is scientifically involved with these matters can aid in clarifying and sharpening the questions that must be answered by the physical and biological scientist as well as the social scientist if values are to be increased or institutions are to be improved.

Four considerations have loomed large in the design of our own research program at Resources for the Future. These considerations may be of some interest in designing your own programs.

One of these is that some of our most pressing and urgent problems in the field of natural resources today in the United States stem from rapid urbanization and the growth in per capita income rather than from the growth in population by itself. These factors have had far-reaching effects upon the demands for land, water and air within limited geographic areas. These concentrations of demand have tended to threaten deterioration in the quality of the human environment at many locations, while at the same time rising per capita incomes have been increasing the demand for improved quality of the resource environment whether it be in and around large cities or in rural areas. Furthermore, value optimization in dealing with these problems is not achieved through simple operation of market forces. There is a need of growing importance to understand all aspects of these complex phenomena because of their significance to the quality of life in America.

Closely related to the foregoing is the fact that one of our major needs, if we are to deal with emerging natural resources problems effectively, is for institutional adjustment. Here at Colorado State University some of you have been interested in water law and its various consequences. I personally feel that this is one of the major water resources problem areas of the whole West. In addition, we need a variety of institutional improvements to deal with such matters as water pollution, air pollution, pesticide contamination, improvement of the urban environment, and preservation of the rural countryside.

In other words, in addition to the study of the physical, biological and economic consequences of a variety of natural resources activities, we also need to understand much better than we now do how society may function to realize the potential values available from natural resources.

A third consideration is the relation of natural resources activities to the economic progress of the depressed regions of the United States. Many of these regions - such as Applachia - are in large part dependent on the primary industries. How can these industries be developed and managed to aid in the economic adjustments necessary to improve the well being of the people who live in these regions?

A fourth consideration which influences the RFF program is the importance of international trade and investment in meeting both our own domestic needs for resource commodities, and the requirements for economic development of many countries about the world. Currently our program gives considerable attention to investments and trade in the field of energy and minerals. We are trying to gain a better understanding of the implications of alternative policies for both exporting and importing countries. The issues that arise are of significant importance to the U.S. domestic economy, to the economies of the developing nations and to international relations.

Finally, RFF has decided to initiate a modest research effort dealing with natural resources in the economies of the developing nations. It is focussed upon Latin America. Certainly the primary industries play a major part in the economies of these nations and the task that lies ahead of them is formidable indeed. The intellectual challenge is great because resource development occurs under different conditions than those which exist in the United States and Western Europe and has not been subject to a high degree of systematic study. The humanitarian opportunity and responsibility is enormous because the viability of reasonably satisfactory societies in these regions depends in large measure upon the ability to develop individuals and institutions within a relatively short time who can deal with the problems they face. It is difficult for any institution of learning to remain aloof to what is happening in the developing regions. Colorado State University has been keenly aware and deeply involved in some of the problems of the developing nations.

## Conclusion

I hope that the foregoing observations will be helpful in deciding how to proceed with your programs in the field of natural resources here at Colorado State University. In my judgment, there are enormous opportunities and I feel that you are particularly well equipped and situated to take advantage of them.

## SEMINAR FIVE

## NATURAL RESOURCES PROGRAMS IN THE UNIVERSITY CURRICULUM

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Presented at
Colorado State University
April 2, 1964

In my comments I hope to discuss several topics which are of vital importance to the question of the place of Natural Resources Education in the University Curriculum:

> First, I want to raise some operational questions particularly related to curricular planning at both the undergraduate and graduate levels; and
>
> Second, I want to discuss my own special interest, namely, the politics of natural resources as related to the education of students with career aspirations in fields dealing with natural resources.

### Curricular Problems -- Undergraduate

The operational questions with respect to curricular planning on which I want to focus reflect my ten years of Government service in resource agencies, my activities over the years on curriculum committees at several universities, and most recently my position

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as acting associate dean of the Liberal Arts College at Wayne State University.

In addition, of course, my own investigations in the field of natural resources politics have shaped what I will be saying.

One question which must be dealt with concerns the very nature of an undergraduate education, and more particularly of the undergraduate major. Just what does it mean when we say that a student "majors" in this or in that? What are the criteria which govern the shaping of college majors.

It seems to me, first, that there are certain internal administrative criteria or requirements for a major, which serve as guides to students in selecting the subjects they are to study. From this point of view, the rationalization of a major is largely that of administrators and faculty, and reflects their values. Often, I am afraid, the construction of major concentrations is based upon attempts to correct mistakes which particular faculty members or administrators feel were made in their own educational programs years before; or conversely merely repeat programs of twenty or thirty years ago, with a course or two added. In any case, I doubt whether students very often share these internalized valuations.

At most schools, to complete an undergraduate porgram requires at least 180 quarter course credits

(120 semester course credits). Of these, approximately 45 quarter course credits will be in the so-called major field, with the balance distributed among what are often called "basic" or "core" requirements (English, Speech, Mathematics, Science, Foreign Languages, etc.) and electives. In some undergraduate programs the student is, in addition, required to complete a certain number of minor or cognate credits. (e.g. the Physics major must complete certain Math courses, etc.) There are variations, of course. In certain scientific fields, the course credits required for the major may be considerable more than 45, and in professional schools the number of electives are usually very few. Within this structure, the term "major" indicates in a rough way the courses and or subject matter which provide the organizing principle for the student's effort.

In addition to these internal or administrative criteria which shape the undergarduate major, there are also external professional criteria relevant to particular disciplines. In a field like chemistry, the American Chemical Society approves and certifies undergraduate programs, just as in a number of professional fields professional accrediting agencies prescribe much of the course program for the student. Most other disciplines follow a more or less traditional approach to the course content of their respective majors. Thus, when a student says he has majored in economics, one can infer within not too broad a range the kinds of courses he has completed. Similarly, when a student says he has majored in Zoology or in Agronomy, it is possible to reconstruct his program on an approximate basis.

A third kind of criteria determing the content of the major come from the student himself. These criteria reflect his own personality, his own ego needs and his training and experience. There criteria may often be unarticulated, but perhaps can best be characterized by suggesting that to the student his program of course work must "make sense". There must be a certain internal logic to the courses he is taking, as well as an external relevance. The external relevance may be simply a career or employment orientation or it may also be related to what parents expect, what peers expect, etc.

Within this context we might ask the question whether an undergraduate major in natural resources has validity, whether it meets the criteria identified above.

It would, of course, meet internal administrative criteria since these are established more or less by fiat. But the external, professional criteria, those which arise from the nature of a discipline, would probably not be met because (in my opinion) natural resources is not a discipline. Programs dealing with natural resources involve many disciplines, and hence the term is only a very general rubric, not even as specific as education or engineering or, (in the humanities), art, or music.

With respect to the criteria which arise from the students own personality and ego needs, it is most difficult to generalize. The student's own background and pre-college experience will be quite relevant, as will a host of individual factors. The one aspect of this set of criteria which may be subject to generalization are, perhaps, those that concern career or employment possibilities and these, I will discuss subsequently.

In discussing undergraduate curricula, we must always remind ourselves that we are dealing with a very finite universe of 180 quarter hours of credit. It has been my experience that many curricular problems might be solved superficially if we extended the undergraduate program by a year or two, as has in fact been proposed for some engineering curricula. I think we must distinguish also between curricular problems of "A" students, and those of average students. I sometimes think that it really doesn't make too much difference what courses the "A" students take provided merely that they are challenged and that the course work is rigorous and demanding. Almost by definition, they are self-motivating, and illustrate most clearly that the learning process is a highly personalized, individual process. The teacher and the course provide only the occasion and a stimulus to learning. But the average student poses a host of different problems, both in terms of pedagogy and in terms of ultimate employment and career development.

To most students, it seems to me, the obvious importance of the undergraduate major is in its relevance to his career expectations and perceptions. Although many of us still subscribe to liberal education goals, high school counselling, commercial advertising (e.g. such as the New York Life Insurance Company's pamphlets on careers), early marriage, and the acquisitive emphasis in our society, all combine to press the student to choose his major study as preparation for a career rather than from more abstract points of view, of knowledge for knowledge's sake. The high cost of higher education together with the aspirations of parents for their children strengthen the "what will I be when I grow up" focus of undergraduate education. So I want to turn now to this question of employment.

## Employment Opportunities for the Undergraduate Major in Natural Resources

If these generalizations about the interests of students in career goals are reasonably accurate, then the answer to the question of whether an undergraduate major in natural resources can be successful may lie in large part in an appraisal of the careers open to such majors.

Most of the concern with natural resources problems lies with government, although there seem to be a growing number of resource using companies very much aware of resource conservation problems. But in my discussion I am assuming that most employment opportunities in the natural resources field are and will contine to be in government. This is partly because of the way in which we have defined natural resources problems in the United States; partly, it reflects government ownership of the public domain; and partly it reflects the history of the conservation movement and resource programs.

Public job opportunities in the natural resources area are of two general types. The first type is technical, that is, the concern is with the management, study, or manipulation of a particular resource, and would include such traditional specializations as ornithology, forestry, weather science, geology, etc. More recently it would also include resource economics and resource marketing.

The second type of job opportunity is at a more general level. Here the emphasis is not on a specialty, but on understanding the interrelation of a number of specialties, on intergration, on synthesis, and by definition, on training which is interdisciplinary. These job opportunities put a strong emphasis upon generalization, on planning and programming, on writing and verbal facility, on effective interpersonal relations, on coordination of people and data, on analytical abilities, etc. These jobs would, in the British civil service system, be in the so-called "administrative class".

Present job opportunities for so-called generalists stem from the fact that today in government as well as in the private sector there is increasing need for a type of generalist skill at lower levels. Sociologists have written about the new white collar class, and its expansion in response to automation and changes in production processes. The same phenomena are bringing about changes in the nature of public employment, and so we are finding a growing need for college educated people to fill the bottom ranks of what a 100 years ago might perhaps have been considered clerical positions, if they existed at all. Most generally these positions are designated "staff positions," stressing the fact that the individual's role is not to make substantive program decisions, but rather to assist a superior, usually a technically trained person, in handling his assignments, particularly the administrative aspects of his assignments.

Education for these new types of staff positions may represent a kind of mid-point between the classical tradition of "general education," with its strong emphasis upon humanistic training, and the other extreme of specialized technical education. If my analysis has a degree of validity, then we might focus upon the kind of education, the kind of courses, that might be appropriate for effectively training this middle group.

In part, the issues are not unlike those which have plagued college curriculum committees for several generations -- i.e. Does the student learn more from comprehensive survey courses than he does from rigorous detailed investigation of a narrowly defined field. Certainly, there is always the danger of superficiality, masquerading under the title of breadth. Unfortunately, I do not know the answer to this question of how students learn, and I have suspicion that there is no simple answer, variables including the student himself, his motivations at the time, and other factors which we may not have identified. I am reminded of the fascinating story of Louis Acassiz, told by one of his students, to the effect that for one whole semester the student lived with a single fish studying its every aspect and constantly being told to go back to his specimen to observe. It is said, along the same lines, that in his course in Constitutional Law, Justice Felix Frankfurter, when at Harvard, would spend one semester on a single case. Most of us who teach Constitutional Law, on the other hand, try to cover a subject more or less systematically and comprehensively. But, how does one learn most? Is it even possible to develop generalists by means of a college education? Or, do these skills and abilities rather reflect the personality, the heredity, and the life experiences of the individual?

The justification for many college programs is that the student should simply be broadly educated since for many kinds of jobs in our society the mere fact of having completed a college education is all that is required. In my own field of political science, for example, I suspect that many of our undergraduate majors end up neither in politics nor in government employment, and I doubt whether they utilize to any great extent the specialized knowledge they accumulated in their major field, except perhaps as citizens. To such, I suspect, the value of college education lies in the exposure to knowledge, to other intellects, and in having provided opportunities and stimuli for intellectual growth.

Whatever the source of generalist ability, I think we must recognize that when effectively developed, it does represent one of the highest skills, as recognized centuries ago by Plato in his references to philosopher kings. Plato, incidentally, stressed the importance of experience in reaching the point at which synthesis and integration -- wise judgment -- might be made (a view supported by some interesting research in creativity).

But to return to the problems of employment for the undergraduate major in natural resources -- As I have inferred, there is obviously a NEED for generalists in resource programs, for people who can relate programs, policies and problems in one field to those in another. But, I would suggest that we examine very carefully whether these needs may not be most pressing at the middle and upper levels of the government hierarchy, rather than at the GS-5, 7 or 9 grades at which most undergraduates begin public employment.

The largest number of college graduates are recruited by the federal government through the Federal Service Entrance Examination for which there are no preparation prerequisites, the examination being an intelligence test type of evaluation. In the federal service, then, once a student has qualified by passing the Federal Service Entrance Examination, he is on his own in finding employment that appeals to him. Presumably a student who has majored in natural resources and done well, will seek employment in resource agencies, if positions are open. If positions are not open, or if he has not done particularly well as a student, I suspect that he is more likely to take any position which is offered him, even though it is not related to his areas of study. In either case, however, we must admit that he will often have only limited opportunity to use his particuar course training. This is just the opposite in the cases of those recruited because they are engineers, biologists, foresters, etc.

The situation at the state and local level is considerably different, since most state and local governments generally recruit for specific positions with very detailed prerequisites. Hence, there are very few positions in state government, and fewer still in local government, for someone with simply a general major in natural resources, or in any other general field. (I am, of course, begging the question of courses taken and program content.)

In other words, state and local governments will employ biologists, foresters, budget specialists, sanitarians, hydrologists, and so forth, but, they are less likely to employ natural resources majors, unless in terms of the courses completed, these majors can also qualify as having one of these more specialized and traditional concentrations. Few states and cities have anything like the Federal Service Entrance Examination to recruit the generally trained student. At the state and local level the civil service system is thus much more rigid, and while as a student of government I may insist that there is a need for generalist type persons (at least many of us who teach political science feel that this is one of the greatest deficiencies in state and local staffing patterns) nevertheless, state and local governments do not often recruit generalists but rather seek to fill very specific positions, with specific technical requirements. At the local level the outstanding exceptions are those jobs leading to city manager careers, and these are few in number.

With respect to the promotional prospects of students with undergraduate degrees in natural resources, it is my judgment that the opportunities would be considerably greater in the federal government than in state and local governments. This is partly because the federal government has so many more employees, and partly because the personnel structure of the federal government is more flexible. Thus the person with generalist abilities will be encouraged. But in most siutations promotion tends to be based on performance, and on availability of jobs.

Studies of the Department of Interior several years ago indicated, that in some fields very real blocks existed after Grades 9 or 11 because the number of higher positions were far fewer than the number of lower positions, and the vacancy rate was not high enough to create sufficient openings for steady promotions. This fact, together with the fact that our governmental system at all levels places a premium on technical training, would suggest that promotional opportunities for a person relying SOLELY on his undergraduate training in natural resources could be quite limited. As a matter of fact, of course, many other factors enter into the promotion decision.

It is worth stressing, however, that we do not have anything like the British or Indian "administrative class" (and I am not sure that I want to see one develop), which provides a separate promotional ladder for generalists.

Returning to the basic question "should there be an undergraduate major in natural resources" my inclination is to respond in the negative. At the same time, I would urge that consideration be given to developing strong minor or cognate concentrations for those who have resource careers in mind, whether these careers would be in agriculture, in engineering, in biology, in earth science, in forestry, in economics, in public administration, or whatever. The emphasis of such a minor should, in my opinion, stress policy problems and policy formation. It might, in fact, amount to almost a second major in terms of the number of credits required. At the same time if it is to meet the needs of the variety of students I have identified, the program would have to be quite flexible permitting considerable adjustment and choice, and being geared to the needs and interests of particular students. Let me explore this a bit farther.

In broad outline, perhaps two general distinctions might be made between the needs of those students who are majoring in social sciences and those majoring in natural sciences. For the social science student with an interest in natural resources I would suggest that a substantial number of science courses be required. But many of the normal science courses may, in many cases, not provide the kind of knowledge and insight which could be of most use to the Social Science major. If there are enough such students, it would, of course, be possible to design special science courses. But, if the number is few, then perhaps we will have to settle for an intensive "cap stone" course, taught by a particularly competent natural scientist, who would seek to present the student with insights into the technical parameters of natural resources problems in particular fields.

The problem for the student with a major in one of the natural sciences would seem to be more readily dealt with. His natural resources minor or cognate might well include a course in social statistics, stressing statistical analysis. It should also include a course in resource economics, emphasizing (among other things) both the concepts and techniques of cost-benefit analysis. Such a minor or cognate should, finally, also include a course in resource politics, emphasizing the nature of the political process, in order to familiarize the student with the extent to which the political system provides the means for making choices with respect to societal goals. In this connection, I would hope that the student would become aware of our plural value structure, and the extent to which we are engaged in a constant effort towards making wiser choices and decisions with respect to resources. I will return to this subject a bit later.

### Should a Graduate Degree in Natural Resources be Offered?

It is my view that the graduate degree in natural resources can provide necessary and useful education beyond the baccalaureate degree. In this connection, it may be useful to distinguish between the Master's degree (probably conceived of as a terminal degree) and the Ph.D. degree.

One conception of a Master's degree in Natural Resources would be that of supplementing a variety of undergraduate technical and specialized programs such as engineering, biology, agriculture and so forth.

The objective in this case would be to provide the student who has already pursued a specialized technical education an opportunity to place his technology in a broader social context -- to permit him to develop a familiarity with policy processes.

A related kind of graduate program would provide mid-career training for public employees, who have been dealing with resource programs and problems. Here the objective would be to supplement formal undergraduate training and particularly work experience. The goal of such mid-career training would be to prepare those who engaged in it for higher level positions.

Mid-career training programs are sometimes justified in terms of preparing the participants for "administrative" positions. It seems to me that this goal is too narrow in that almost by definition as one moves up the hierarchy in government agencies more and more time must be devoted to administrative and policy matters. This would be true even with respect to many research positions, because even higher level specialists are constantly involved in planning, in making choices and setting priorities. To do this intelligently requires a knowledge of the larger context within which even a research program must go forward. It might be noted, in passing, that too often technically trained poeple, even after they have had work experience, fail to recognize that a basic social problem is that of choosing among alternatives and setting priorities in areas where available knowledge is less than complete, and where operative factors and forces are usually very complex.

It seems to me that a meaningful graduate program either for those who continue on without any work experience, or for the midcareer public employees should emphasize policy processes, so that the student becomes aware of the political, social, and psychological context within which natural resources programs go forward. The student should also be trained in analytical techniques appropriate to such policy problems. Here an understanding of systems analysis would be useful, as would be an understanding of related economic cost-benefit approaches. In respect to the latter, the emphasis should not be on simply how to conduct cost benefit studies, but rather on the philosophical and conceptual framework, on value premises which underlie such studies, and on their limitations. To develop his analytical skills the student will of course require a fairly wide-range of courses, including courses in statistical analysis.

The question of program flexibility can only be answered in terms of the backgrounds of the students. If they all gave similar backgrounds then a rather rigid course sequence may be established.

But, if they have diverse backgrounds (and I believe that it would make sense to encourage the widest possible diversity) then much greater flexibility would need to be built into the program. One technique that appeals to me (modeled after the graduate program in political science at Northwestern University) would be to design an intensive graduate level survey course, taught by several faculty members, perhaps from several disciplines and offered in three terms. Such a course might represent approximately one-third of the graduate student's load.

With respect to the Master's degree in natural resources, one question that might be examined is whether such a degree should have longer time requirements than most Master's degrees today. There is a general presumption that a Master's degree can be earned in one year after the baccalaureate degree. On the other hand, there are some two year Master's degrees, and it might be argued that a graduate program in natural resources should involve more than one year of study. This would clearly pose difficulties in the case of federal midcareer training programs and probably in other cases also. But the questions should be examined and disposed of.

It should be clear that my conception of a Master's degree program in natural resources is that such a program should seek to develop in the student those integrative skills that will permit him to deal more effectively with policy problems in the natural resources field. In addition to the general seminar which I have suggested, the student might (depending on his previous background) properly be exposed to rigorous courses in resource economics, since economics is concerned with fundamental questions of resource allocation, and to courses dealing with the political process (by which I mean not simply party activity, but the whole chain of activities involved in making governmental natural resources decisions) I am sure that in many cases students will find difficulties in scheduling all of the courses which might profitably contribute to their particular interests.

Especially for the mid-career training program, courses in personnel administration emphasizing interpersonal relations, in budgeting, and in similar practical subjects might be desired. But I tend to minimize these kinds of courses, unless they clearly rise above techniques to consider fundamental government decision processes.

With respect to a Ph. D. degree in natural resources I have considerable uneasiness. Government agencies place low value on doctorates that are not in some technical or specialized field. In my own case, for example, the fact that I hold a Ph.D. in

Political Science has never been a major factor in securing federal employment or in being promoted. The situation is quite different in the case of scientific degrees and research positions. With respect to teaching, the doctorate in natural resources would have very limited utility, because most colleges and universities find themselves under great pressure to hire people with degrees in more or less traditional disciplines, even when seeking special competence in a field like natural resources. Degrees like the doctorate in public administration or even the doctorate in education are regarded with some suspicion by many faculties.

With respect to the question of employability of persons who have completed a graduate program in natural resources, it seems to me that this will depend partly on the nature of the program, and partly on their interests. If they have had a strong undergraduate specialty, the addition of the Master's degree would considerably increase their employability assuming that the Master's program would emphasize the kinds of policy questions referred to previously. The mid-career personnel would, by definition, continue in their careers.

### Are short courses or institutes desirable?

It seems to me that short courses or institutes could play a very important role, both for the university and for the participants. The contribution to the university of short courses or institutes would be to provide opportunity for students and faculty to be exposed to the points of view and interests of persons active in natural resource programs. The benefits to the participants would presumably be in terms of broadening their perspectives on the nature of resource questions. The various kinds of short courses or institutes that might be developed are infinite, ranging from conference programs of very short duration designed to appeal to citizen groups and citizen leaders or designed for particular groups of public employees. A program of several weeks duration for engieers working with water problems, for example, could provide opportunities for relating the engineer more effectively to the social and political context within which his activities take place. In this connection, you may want me to enlarge upon the so-called executive or management development programs for public employees in which Wayne State University has pioneered.

## What kinds of research in natural resources is most urgently needed?

In part, the answer to this question is a function of the kind of program that is set-up. If the program emphasizes policy problems and seeks to orient technically trained people to the context within which resource decisions are made, then additional research in the policy area is needed, dealing with both economic and political aspects of resource policy decisions. I would stress that in many respects the economic and the political are complementary, reflecting different kinds of value frameworks and different kinds of choices. This perhaps best illustrated in the RFF pamphlet on Water Pollution by Allen V. Kneese. The focus of economic analysis is efficiency, measured in non-market situations by cost-benefit analysis. The political process, on the other hand, is primarily concerned with value choices, and here research needs to focus on consequences of alternate decisions, as well as on the decision process and on factors influencing decisions. In effect, we are dealing with processes of change, whether studying natural resource problems in our own country or in foreign countries. Many of these processes involve economic dimensions, but other social and political factors are also involved, which have often been overlooked.

## Where are the gaps in texts and other study materials in natural resources?

To answer this question would require a systematic survey of available materials relating to course goals. But, let me at least identify one major deficiency which I find in many of the materials relating to natural resources policy questions. This deficiency concerns the extent to which proposals and programs are presented as representing the best and only solution to a particular problem, without recognizing the complex value premises which underlie such proposals and programs, or assessing possible alternatives, value conflicts, or political feasibility. Students of natural resources must be weaned away from the moralistic emphasis of the "woodmen spare that tree" approach, to a recognition of the plural character our values and the complexity of the decision problems in our contemporary society (reference might be made in this connection to a recent book by Paul Diesing entitled Reason in Society: Five Types of Decisions and their Social Conditions. University of Illinois Press, 1962). An awareness of the value premises which underlie resource programs would among other things help in dealing realistically with the time dimension. None of us are yet able to foresee the future with any degree of precision, yet most resource decisions rest on premises with respect to the future. But we need to indicate what future we are talking about and recognize the range of possible policy solutions.

## Natural Resources and the Political Process

The balance of my time I want to devote to the topic which is of most interest to me - - THE POLITICS OF NATURAL RESOURCES - - and which I believe strongly should be a vital part of any curriculum in the natural resources field.

In popular parlance, politics is often something distasteful, something to be avoided. We speak of "office politics" or "university politics" connoting thereby something which is not quite proper. If someone whom we think is unqualified gets a particular job, we say "Oh, he played politics". Despite the fact that Aristole stated many hundreds of years ago that man was a political animal, we have in the United States had ambivolent feelings with respect to politics. At the local level, particularly, there have been strong movements to get politics out of government and from this movement have come the non-partisan elections of many of our cities. And, in one state, Minnesota, the legislature is elected on a non-partisan ballot.

In times past, many political scientists were at the forefront of reform movements which emphasized non-partisanship. But today political scientists have begun to reorient their thinking, recognizing the political process as a vital part of our societal structure, necessary to the making of choices both as to means and as to ends. Our political institutions have developed in order to permit or to facilitate choices. And the political process, then, is concerned with making decisions, decisions backed by the authority or sanctions of government.

Many early political scientists and many citizens have misunderstood the function of politics because, with Madison (particularly in the Tenth FEDERALIST Paper) and others of the founding fathers, they assumed that the only choices which confronted society were choices between what was correct and what was in error. The 18th Century emphasis on "right reason" very easily led to a host of misconceptions about partisan activity, about the nature of the political struggle, and about the motives or intelligence of one's opponents.

Many factors have contributed to undermining these simplistic views, so that today political analysis begins with the fact that society is confronted with plural alternatives resting on plural value premises, the validity of which must often simply be assumed or measured in operational terms. It is in this context that our political-governmental institutions are recognized as mechanisms for choosing among alternate goals and in the process of choice for working out compromises and accommodations.

In the 1930's there was in many circles a simplistic assumption that government planning would result in correct economic decisions. This simple faith in planning as the rational solution to societal problems is to be contrasted with the complex arguments which go on today as to how best to stimulate economic growth. Most everyone wants economic growth. But is is through the political process that viable (not necessarily correct) decisions involving plural values and plural alternatives for achieving such values are made. As a result, our political-governmental institutions must be studied (and understood) in terms of their role and function in the selection of values and of means for realizing them.

All decisions, unfortunately, deal with the future, and while we hope to improve our techniques for understanding cause and effect relationships, so that the future may be less uncertain, we must constantly remind ourselves and our students that policy decisions rest on a host of assumptions with respect to future conditions, what the Paley Commission called "The Clouded Crystal Ball." A simple historical illustration of this is the concern expressed by the first Conservation Commission in 1908 regarding an expected coal shortage in the 1930's. About a decade earlier Sir William Crookes had predicted world famine by 1931 because of a shortage of wheat. Given the premises on which these predictions rested, they were reasonable. But, of course, it was the premises which were in error.

We as intellectuals and as inheriters of democratic traditions are dedicated to ever more rational decisions. In this sense we share the goals of Jefferson and his 18th Century peers. And, certainly the history of our government's relationships to natural resources is evidence of the constant struggle to increase the rationality of resource decisions. But for many reasons, resource policy has not been an example of "pure reason." It is in this field where "pork barrel politics" and local or regional interests often obscure national interests. These situations we must bring to our students.

At the same time, it seems to me, that the dominant trend line in resource policy has been a continuing if not always successful search for the public interest. Perhaps here a caution is in order so that we do not present our students with an over-rationalized model of reality. We must bring them to recognize the extent to which myths and rationalizations of selfish and local interests have been involved in policy formulation and in this connection we should perhaps seek to develop a healthy skepticism and an antidogmatism in their approach to policy analysis. They should learn to ask questions and we should encourage a constant appraisal and reappraisal of consequences, analyzing results in terms of their effects.

In the following pages, I want to outline some of the elements of the political process which should form the basis of a course of courses designed to orient the student of natural resources.

## Characteristics of the Political Process

The end product of the political or governmental process is decision and action. A study of political or governmental processes is a study of decision-making, of the factors and forces which converge to result in particular policy and program decisions.

The governmental process is purposeful. It operates in relation to goals; it seeks to achieve objectives; it responds to the stimuli of felt or identified needs. Whether these needs are real or assumed, accurately diagnosed or properly prescribed for is of secondary relevance to their effectiveness as stimuli or catalysts. It is worth emphasizing that the goals, the objectives, the needs -- these stimuli to governmental activity -- are plural in character. They are in fact largely asymetrical and may even be inconsistent and conflicting. They are often composites of reason and non-reason. They present evidence of the rational, the non-rational, and even the irrational in human existence. And the resultant programs and policies bear the stigmata of their birth processes.

Although policy is often described as monolithic, more accurate perhaps is the recognition that many forces and factors stimulate policy decision and condition policy direction. Public policy is in general not logically unified nor tightly integrated. Even within a narrow program field, piecemeal decisions and responses to particular problems often result in a policy structure that is far from neat and symmetrical. The institutions of governmental decision making in the U. S. do not encourage a high degree of attention to inter-relationships among decisions and a careful consideration of consequences.

The process (or that part of it subject to study at any particular time) operates in a context - the environment within which decisions are made - and this context must also be understood and analyzed since it affects, even limits and determines, the direction, scope and content of the decisions which result from the operation of the political process.

Within the environment or context are included such factors as: 1) The structure, machinery and institutions of government, their informal and operational as well as their legal and formal aspects; 2) the condition of society, its culture, its values, the economic system, etc.; 3) factors of political and social behavior such as leadership and personality; 4) the ideas, beliefs, myths and symbols together with the knowledge or lack thereof (ignorance) operative at a particular time and place and in relation to particular circumstances and situations.

Policy decisions are not the result of spontaneous generation. They are responses to felt needs -- attempts to deal with identified problems. The situation that gives rise to decision may be recognized by the public generally, or it may be intensely felt by a very few. In the latter case the folk-saying that the "squeaking wheel gets the grease" would often seem apt. It is not at all necessary that the problem be correctly or objectively identified and defined. Neither is it necessary that the solution be appropriate to the problem. Stated goals need not be real goals. Often it is impossible causally to connect ends and means, or to determine reasons or motives which led to a particular policy or program. And to separate real motives from rationalizations may be difficult or impossible.

Rarely is a need felt broadly enough and a problem recognized clearly enough to result in spontaneous support for a particular program or policy. Hence, the need for leadership. Hence, the necessity for promoting both an awareness of the problem and its importance, and the appropriateness of particular solutions for dealing with it. Typically these promotional activities involve the building of alliances and alignments, focused on the points at which crucial decisions are made.

In a society which places great stress upon majority rule the effort is in the direction of convincing decision makers that if not a majority, then at least a significant segment of the population favors (or would favor) a particular program or policy.

Claims exceed reality by many times, and practice obviously departs from theory. First, rarely does a majority favor a particular policy or decision in the simple referendum sense. Here, the major difficulty is that in reality only a relatively few have even a dim understanding of policy issues. Of almost equal difficulty is the determination of view points of those who may actually understand the issues. Institutions for this purpose are weak or non-existent. Voting is of little direct value because party activity is rarely issue-oriented and political parties are (in this context) patently irresponsible. The operation of the federal system, the size of the country, and the single-member district basis of geographic representation encourage consideration of particularized local problems outside the context of broadly identified national interests. Thus it is through the accumulation of support at successive geographic levels that many crucial questions are decided, rather than by the simple process of majority rule.

And the tendency to accommodate has fullest play, since the doubts which might be identified by logical analysis and rational calculation are rarely voiced.

Constant actions and reaction among many forces and factors involved in public policy decisions is characteristic of the governmental process. Various terms have been applied to this aspect of the process, including "struggle," "conflict," "tension," "competition," and "counter-vailance."

The stress on struggle is in fact another way of saying that a study of political process must be concerned with the distribution and allocation of power and influence, with the interaction among individuals and groups, with the forming and reforming of alliances and alignments. Much of this is suggested by the graphic definition of politics by Harold Lasswell: "Politics: Who Gets What, When, How."

The concepts of struggle, however designated, all imply people as participants, those who are advantaged and those who are disadvantaged. But while ultimately the basic unit in the process is the individual, it is apparent that in most situations individuals are organized into groups or groupings, which are the actual participants in the struggle. The place of the group in the process of government (which has been recognized from Aristotle on) has in recent decades become an important part of political analysis.

Earl Latham, elaborating somewhat on the Aristotelean definition of man as a political animal, has stated "politics concerns itself with the patterns of *organization* by which human wit and energy are *brought together in a structure* of orders and functions to accomplish, *through this collectivity*, what is beyond attainment of any individual part of it."

I do not accept the idea that the struggle inevitably produces countervailing forces which effectively check each other and thus bring about good and desirable results, nor the view that value results are indifferent and the public interest criteria irrelevant. I would stress rather, that the political process can and often does seek and work toward decisions which *are* in the public interests, and that such a desirable result is possible where the institutions involved in governmental decision-making evidence strong biases toward rationality and where society includes among its values an effort to increase logical calculation and rational control in the definition and realization of public purpose.

My view assumes that in democratic America there is a strong and persistent belief that facts should outweigh fancy, that reason should overcome ignorance and prejudice, and that choices and decisions in the public interest can be made. At the same time it is recognized that the definition of the public interest is no easy matter. This is partly because for the foreseeable future that which we know will continue to be infinitesimal when compared to the unknown. Hence, the purpose of the governmental process is the search for the public interest, to which search the free trade of ideas, the conflict and struggle among groups and interests, and the constant appraisal and reappraisal of experience is essential.

It is unreasonable and unrealistic to posit a policy process which produces only correct answers. At the same time, as knowledge and insight, experience and technique develop the determinations of public interest should improve.

But it is especially because of present limitations on complete knowledge (and perhaps even though the quantity of knowledge increases tremendously, the ratio of the unknown to the known will remain more or less constant) that the political process as it operates in the United States is in fact an effective means for making societal decisions which combine so many facts and factors, values and beliefs, elements and interests. Like the market place concept of the economists, the political process as here described provides a means for bringing those multiple forces, interests and influences into play. The economist is concerned with the allocation of resources; the political scientist (and political process) with the allocation of power and the fruits of power.

The subject matter of a course in the field of resource politics would thus deal with those elements of the decision making process which the economist often dimisses with the convenient and necessary phrase "ceteris paribus." It is easy to forget the extent to which efficiency models and cost-benefit analyses rest upon the deliberate exclusion of many factors and values which may often be of crucial importance to individuals and to society. Maximization of welfare seems like such an eminently logical goal, that it is very easy to overlook the many other values of society and assume that economic efficiency is the only valid measure. Often, largely because cost-benefit analyses are carried out at levels considerably below those required by the pure theoretical concepts, fundamental premises of program goals (with respect to which efficiency is sought) are not analyzed. Too often, for example, alternate expenditure patterns are not even considered. To illustrate, a unit of higher education may be more important than an additional unit of flood control. But such choices are beyond the ken of most cost-benefit studies, although implicit in theoretical formulations.

It is this problem with which Herbert Simon has dealt in his suggestion that public decision making as a matter of logic cannot deal with "maximization" because the total number of alternatives can never be brought together for appraisal at any one time of decision. He suggests, instead, the concept of "satisficing" as indicating a more realistic concept of public decision making. By this term Simon means to emphasize the temporal and intellectual impossibility of making maximization decisions in the real world of administrative organizations.

One recent work by economist Alan V. Kneese of Resources for the Future to which I have already referred (Water Pollution, 1962) clearly recognizes the place of political decisions, (i.e. choices) with respect to the expenditure of public funds. But, in my opinion, Kneese still does not go far enough, partly because in our economy it has SEEMED possible to spend money for all the things we wanted to do, and few policy makers have felt a real urgency for establishing priorities among activities and between sections of the country. I am not at all sure, however, that this euphoric situation will continue as our population approaches 300,000,000 living in the metropolitan complexes unevenly distributed around the country.

It is in this context of increasing population and consequent pressures on resources that I feel that choice and priority questions will become more and more pressing. If this is likely, then those of us interested in natural resources must increase our awareness of the choice problems which society faces and the consequences of following one or another course. For this reason, too, we should be training our students and preparing them for intelligent approaches to these choice problems. To me this means not pat solutions, but an awareness of the interplay of interests and values and a sensitivity to the complex factors and forces relevant to political-governmental decisions.

The student interested in natural resources should therefore come to understand fundamental concepts of social and political processes, and to interpret social trends and developments as they might relate to resource uses. Dogmatic doctrines of so-called "wise resource use" must be qualified by an awareness of the necessities for maintaining a viable society.

The student also should gain some insight into the relationship of the American economic and political system to the rest of the world. In this latter area lie some really difficult ethical questions. Perhaps we can leave the ethical questions of America living on Park Avenue while the rest of the world figuratively lives in the slums to the churches, but at least we should make our students aware of the economic and political consequences of the fantastic imbalances between the level of living of Americans and of most of the rest of the world.

# CONCLUDING STATEMENT

The series of seminars just concluded has brought together practitioners and students from every major field with a resources interest. Seminar participants were responsible administrators and educators with a tremendous range of experience in resource management. From such a group one could not expect unanimity on all issues. However, there was a remarkable degree of general agreement on several major issues. These areas of general agreement, as understood by the writer, are summarized below.

1. An undergraduate curriculum in natural resources is defensible and may be desirable as a "general education" or "liberal arts" type program.
    a. Graduates of such a program would probably have limited vocational and promotional opportunities with most natural resource organizations.
2. Participants were nearly unanimous in contending that most present university programs are inadequate in providing the kind of training that is desirable for resource managers.
    a. Much of the criticism referred to over-specialization and the need for "broadened" education.

b. Notwithstanding the general criticism expressed in a. above, there were no recommendations for "diluting" or reducing requirements for professional undergraduate degrees.

c. In consideration of the dilemma posed in a. and b. above, a 5 and 6 year undergraduate program would appear to be the obvious solution. There was, however, little enthusiasm for substantially lengthening the undergraduate program.

3. The split-major was proposed as an answer to the problem posed in item 2. The split-major would overcome some of the inadequacies of most conventional training. Presumably the student with a split-major would emerge from a 5 or 6 year program with two undergraduate degrees or possibly with one graduate and one undergraduate degree.

4. With the exception of the liberal arts oriented program and proposals for the split-major, there seemed to be little inclination to make drastic changes in undergraduate curricula. There was general agreement, however, on the need for, and the opportunities in, revised programs of graduate study. Categories of graduate study which appeared to receive most support are summarized

below.

a. Graduate work in the student's area of original specialty mainly to train research s scientists.

b. "Retooling" and updating of technicians in their specialization. Such training would probably not lead to a graduate degree.

c. A "broadening" program in Natural Resources leading to the Masters degree. Such a program would be designed to expand the horizons and broaden the understandings of persons trained in one of the conventional resources specialties.

d. A graduate program for managers and potential managers with a concentration in Economics, Policy Formation and Public Administration.

5. There was general agreement that increased exchanges of personnel between resource organizations and the universities would be highly desirable. The high cost of such exchanges in terms of re-location of families and loss of momentum was recognized.

6. The need for better coordination of research between the universities and operating agencies was emphasized.

7. There appeared to be general understanding that the management of the nation's resources is not the province of any single discipline and that policies and practices dealing with a single resource inevitably have consequences for others.

Phillip O. Foss